Template for ISB Documentation of Stressors

A. General Information:

1. Name or Location of Example/Approach: Japanese rivers

2. Literature/Citations Used: Fausch, K.D., C.V. Baxter, and M. Murakami. 2010. Multiple stressors in north temperate streams: lessons from linked forest–stream ecosystems in northern Japan. Freshwater Biology 55 (Supple. 1):120-134.

3. Reviewer(s): V. Resh

B. Specific Questions:

1.What stressors are considered? deforestation, channelization, erosion-control dams, biological invasions and climate change

2. Are stressors categorized? If so, how? As above

3. Are the relations between stressors and management objectives modeled, and if so, how? Stressors have usually been tested individually, but in nature they act together. Three theoretical models have been considered by Folt *et al.* (1999): comparative, additive and multiplicative. These refer, respectively, to cases where the effect is simply that of the single worst stressor (i.e. a limiting factor), the effects are purely additive, or the effect of one stressor is further modified by another stressor. For example, if one stressor reduced performance by 50% and another by 25%, then the total effects under the three models would be 50, 75 and 62.5% reductions in performance. In the last case, multiplicative, the second stressor would reduce the remaining 50% by 25%, or an additional 12.5%. In addition, managers often want to know whether the actions of stressors are synergistic (greater than predicted) or antagonistic (less than predicted), but these must be evaluated in reference to a given model of multiple stressor effects. For example, detecting a significant interaction using standard analysis of variance (anova) indicates departure from purely additive effects, or if data are transformed using logarithms it indicates departures from multiplicative effects.

4. If stressors are prioritized, describe the general approach. Two studies of multiple stressors revealed that each stressor alone reduced food web components like abundance of stream benthos or riparian spiders to low levels (35–83% reduction; mean 59%), beyond which an additional stressor had little effect. Synergism and antagonism are less relevant when individual stressors have such large effects. Small streams in Hokkaido are highly sensitive to many individual stressors and have little resistance or resilience to their effects.

5. How might this approach be relevant to Bay Delta? Each stressor alone can reduce biota strongly, indicating that restoration will need to consider all simultaneously to protect biotic diversity.

6. Follow up regarding additional questions/literature review/etc? This study applied to small streams. Is there evidence that large rivers behave differently? And what if effects are synergenistic?